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ABSTRACT

Some of the instructional techniques developed by the mathematics reform movement are effective with Limited English Proficient (LEP) students, whether instruction is provided in the student's native language or in English. The following assumptions lead to good instruction: (1) students are capable of learning advanced mathematics regardless of their fluency in English or the ability of their teacher to speak their native language; (2) computation skills are less important than an understanding of mathematics; (3) number facts can be learned fastest in the context of understanding mathematics; (4) students should be exposed to large amounts of content; and (5) students' everyday lives provide sources of mathematics knowledge. A mathematics curriculum for LEP students should include the following approaches: (1) adjusting the linguistic complexity of learning tasks; (2) teaching "mathematics language"; (3) asking students to devise problems from their own experiences; (4) including course content recommended by the National Council of Teachers of Mathematics (NCTM); (5) presenting mathematics as a social task; and (6) designing assessment methods appropriate to the curriculum. Active Mathematics Teaching (AMT), a form of instruction that conveys large amounts of highly structured information to beginning students, and Cognitively Guided Instruction (CGI), which focuses on student thought processes while solving problems, show great promise for use with LEP students. A list of eight references is appended. (FMW)

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ERIC DIGEST

TEACHING LIMITED ENGLISH PROFICIENT STUDENTS TO UNDERSTAND AND USE MATHEMATICS

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UD 028 128

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TEACHING LIMITED ENGLISH PROFICIENT STUDENTS TO UNDERSTAND AND USE MATHEMATICS

Introduction

Understanding and using mathematics are increasingly crucial to an individual's ability to function in society and succeed in the job market. Nevertheless, students lacking proficiency in English often have been denied access to an adequate mathematics education because educators believed that it was necessary to significantly improve their English language skills before even attempting to teach them more than basic computational skills.

Recent research and experience suggest, conversely, that some of the techniques developed by the reform movement in mathematics are effective with Limited English Proficient (LEP) students, whether instruction is provided in the students' native language or in English. Math instruction can even help promote students' fluency in English when used in concert with other bilingual instructional methodologies.

This digest presents some basic techniques for teaching mathematics with understanding to LEP students and briefly describes two instructional programs that have demonstrated effectiveness.

Assumptions That Lead to Good Practice

Students are capable of learning advanced mathematics whether or not they are fluent in English and whether or not their teacher can speak their native language. Students who are taught math in their native languages will transfer that knowledge to English as their language skills improve.

Only a small part of mathematics knowledge consists of the ability to compute. Far more important is an understanding of math that allows students to link what they are learning to previous knowledge and to explain why they believe something is true in a way that is sensible to someone else. Such math understanding also enables students to apply what they have learned in new settings.

While students should learn number facts, they can memorize them more quickly and easily within the context of learning to understand math than through drilling in a vacuum.

In general, students should be exposed to more content than has been done traditionally. The practice of going over the same content repeatedly year after year (via what is known as a "spiralling curriculum"), instead of moving on to cover more challenging content that incorporates what has been covered before, limits students'opportunities to learn.

Students' everyday lives provide sources of mathematics knowledge, regardless of their cultural backgrounds. Drawing on this naturally developed knowledge both facilitates teaching math and demonstrates its practical usefulness.

Developing a Meaningful Curriculum

Since LEP students can learn mathematics by solving problems (Secada, in press; Carpenter & Moser, 1983), their learning tasks should be adjusted in terms of linguistic complexity, but the mathematics should not be simpler than it is for other students. LEP heterogeneous cooperative groups have been shown to be particularly effective learning settings for LEP students (De Avila, Duncan, & Navarrete, 1987).

Teaching students "mathematics language"—unique terms, symbols, and expressions that occur in math discourse—enables them to communicate on the subject and to clarify their math thinking as it develops language skills (Cuevas, 1984). On the other hand, using "key words" or rules to teach math can limit students' ability to solve problems that are presented in ways that use the key words differently or confound the rules.

It can be both efficient and effective to combine math and language development in a single activity, but one goal should be chosen as primary when planning the lesson.

Asking students to devise math problems from their own experiences increases their interest, concretizes the subject, and demonstrates math's usefulness. It also promotes multiculturalism.

The Curriculum and Evaluation Standards (National Council of Teachers of Mathematics, NCTM, 1989) provide specific recommendations for math course content that will help students meet future workforce and personal needs. New content should include number theory, discrete mathematics, probability and statistics, geometry, and measurement. Teaching students complex computations (such as adding long columns of figures or doing long division, where use of pencil and paper is required) should be deemphasized, since more efficient tools like calculators are easily available.

Students can best master the content proposed by NCTM if it is presented in meaningful contexts that call for students to reason and conjecture when solving problems. Math, thus, becomes a social task—something that students do, alone or together—rather than something they absorb. While bilingual settings are most appropriate for teaching this kind of math to LEP students, all-English classrooms can be adapted to allow all students to participate in the social interactions necessary for learning. Fostering communication among students develops language as well as thinking skills.

Math curriculum should dictate assessment, not the reverse.

UD 028 128

Too often, and particularly in compensatory education programs, achievement testing leads to teaching to the test, and this results in emphasis on students' ability to memorize number facts rather than to use reason for problem-solving.

Sample Instructional Programs

Two types of math instruction programs are promising for use with LEP students in both bilingual and all-English classrooms. Each program can be adapted for teaching elementary and higher level math.

Active Mathematics Teaching (ATM). ATM is a form of "direct instruction" whose function is to convey large amounts of highly structured information to students just beginning to learn a subject (Good & Grouws, 1979; Good, Grouws, & Ebmeier, 1983). It prescribes a sequence of teaching behaviors organized around a math lesson that consists of 8-10 minutes on review, 20-25 minutes on developing new content, and 10-15 minutes on seatwork, which can be supplemented by homework. Each lesson in the sequence builds on the last. The teacher provides process explanations, illustrations, and demonstrations, while frequently checking students for comprehension.

Teachers using ATM in classes with LEP students can facilitate their learning by providing the definitions of math language in ways that students are sure to understand. Frequent monitoring of students' understanding prevents misconceptions from taking hold and allows teachers to match the pace of the lesson to the students' ability to master each component.

Cognitively Guided Instruction (CGI). CGI requires that teachers focus on students' thought processes while they solve math problems and that the teachers use this information to guide their instructional decisions (Carpenter, Fennema, Peterson, Chiang, & Loef, 1990). Ongoing assessment of what students understand is critical to this instructional technique. Students develop both basic skills and higher ordering thinking through problem-solving activities. Moreover, experience has shown that students in CGI programs have better number fact recall than do students who practice number facts outside a problem-solving context. Students should be encouraged to engage in math problem-solving at any time during the day that a question arises, regardless of the course content being taught at the time; this not only increases students' opportunities to learn math but demonstrates math's usefulness in all aspects of life.

To use CGI effectively with LEP students, it is often productive to invite them to express themselves in the language they can use most comfortably. While extra time may be needed for translation so all students can understand each other, the benefit is that students are learning to communicate using math language that can be transferred as students' English fluency increases. The translation process itself can foster greater English fluency. Homework that takes the form of problem-solving not only promotes students' English language and thinking skills, but can help parents better understand the value of learning mathematics.

Conclusion

Teaching mathematics with understanding to LEP students provides them with a tool for successful living that native English speakers have traditionally been given. It also offers them an opportunity to increase their English fluency at the same time as they acquire other skills. More important is development of the ability to communicate their answers and the reasons for them. Students transfer math knowledge learned in their native language to English. Advanced math courses should be made available to LEP students, either as part of a bilingual program or in all-English classes. Finally, teachers should encourage students to take advanced courses, and should expect that all students will master the material.

—Wendy Schwartz

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This digest is based on a monograph, *Teaching Mathematics with Understanding to Limited English Proficient Students*, by Walter G. Secada and Deborah A. Carey. In addition to providing an in-depth discussion of the principles of teaching mathematics, the monograph demonstrates the use of Active Mathematics Teaching and Cognitively Guided Principles in teaching basic math. It is available for $8.00 from the ERIC Clearinghouse on Urban Education, Box 40, Teachers College, Columbia University, New York, NY 10027.

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